

Polybenzoxazine Materials for Radiation Shielding, Phase I

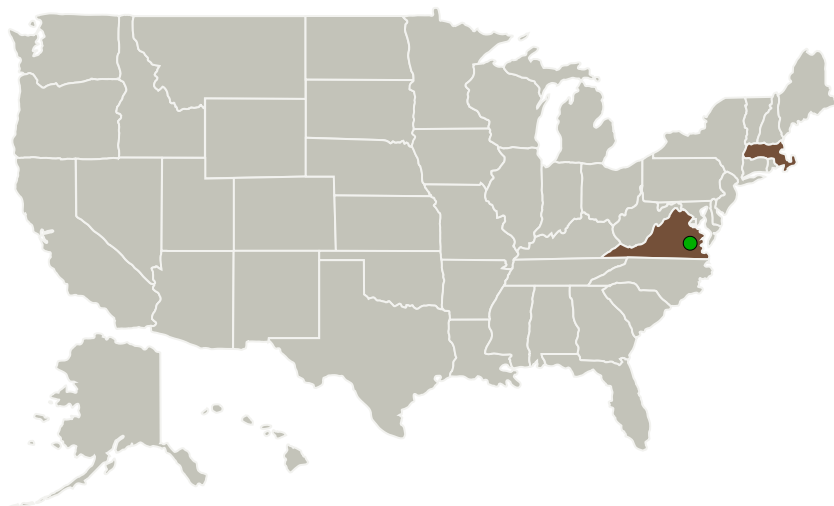
Completed Technology Project (2014 - 2014)



Project Introduction

The proposed work will develop lightweight multifunctional composite materials based on high hydrogen content polybenzoxazine (PBZ) composites that provide excellent radiation shielding capabilities as well as high strength, stiffness, and toughness. This approach provides a novel path to addressing NASA's need for lightweight radiation shielding materials that can also serve as structural members and provide protection from micrometeoroid impact. Polybenzoxazines are organic thermosetting polymers that can be tailored at the molecular level to optimize characteristics that are particularly advantageous for radiation shielding applications, such as high hydrogen content. Polybenzoxazines are also easily synthesized from inexpensive raw materials and the precursor, either monomeric or polymeric, can lead to cross-linked, lightweight, and thermally stable polymers. Our project will address the radiation shielding needs identified by NASA by developing lightweight composites containing a high hydrogen content polybenzoxazine resin matrix and ultra-high molecular weight polyethylene (UHMWPE) reinforcing fibers. UHMWPE fibers are the preferred reinforcing fiber for radiation shielding applications due to their high hydrogen content. Recent developments in PBZ chemistry now allow for crosslinking at lower temperatures that will not be detrimental to the polyethylene fiber structure.

Primary U.S. Work Locations and Key Partners



Name	Structure
bisA/C ₁₂	
bisA/C ₁₈	
C ₁₈ additive	

Polybenzoxazine Materials for Radiation Shielding Project Image

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Organizations Performing Work	Role	Type	Location
Material Answers LLC	Lead Organization	Industry	Weston, Massachusetts
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Massachusetts	Virginia

Project Transitions

▶ **June 2014:** Project Start

✓ **December 2014:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140524>)

Images

Name	Structure
bisA/C ₁₂	
bisA/C ₁₈	
C ₁₈ additive	

Project Image

Polybenzoxazine Materials for Radiation Shielding Project Image
(<https://techport.nasa.gov/image/136797>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Material Answers LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Chris Scott

Co-Investigator:

Chris Scott

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Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.5 Radiation
 - └ TX06.5.3 Protection Systems

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System